NATIONAL SCIENCE POLICY AND TECHNOLOGICAL PROGRESS

BY

ERWIN EUGENE LIEBHAFSKY

B.S., A. and M. College of Texas, 1947
M.S., A. and M. College of Texas, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1950

URBANA, ILLINOIS

1950

NATIONAL SCIENCE POLICY AND TECHNOLOGICAL PROGRESS

BY

ERWIN EUGENE LIEBHAFSKY

B.S., A. and M. College of Texas, 1947
M.S., A. and M. College of Texas, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1950

URBANA, ILLINOIS

1950

R. UNIV.
BIBLIOTHEEK
LEIDEN

NATIONAL SCIENCE POLICY AND TECHNOLOGICAL PROGRESS

I. *Scientific Research and Technological Progress*

Scientific research, the observation and interpretation of facts, constitutes a means whereby mankind is able to utilize more efficiently the economic resources provided by nature. Basic scientific research investigates the fundamental laws of nature, interprets information on their operation, and is directed toward the advancement of learning which results from the discovery of truths. Its success is not measured by the criteria of utility and profit. Consequently, basic research cannot support itself. Historically, colleges, universities, and non-profit research organizations, depending upon the financial contributions of others, have been the centers of basic research in the United States.

Applied scientific research, the pursuit of planned programs toward the achievement of predetermined ends, is conducted primarily in industrial laboratories. Applied research utilizes the fundamental tools and techniques resulting from research in the basic sciences. It seeks to conquer obstacles which stand in the path of production and is undertaken by private industries in the hope that the invested funds ultimately will be recovered. Applied research, then, must result in economies, reduced costs, and increased profits, if it is to continue.

Technological advances result from the successful application of fundamental tools and techniques to production problems. When technological advances assume a continuity, a cause-and-effect relationship, technological progress has occurred. Technological progress, the dynamic, progressive agent of social change, can occur only when a constantly-growng fund of basic tools and techniques is applied continually to new problems. The role of basic research in technological progress is fundamental; for the continued and

repeated application of existing tools and techniques to new problems, as well as the application of new tools and techniques to existing problems, results in mere technological advances. The required continuity of technological advances demands a fluidity of social, legal, and economic institutions. So long as obsolete institutions maintain their rigidity, technological progress cannot occur. The institutional rigidity of the Amercian patent system and the emphasis placed upon applied research by American industry constitute two major obstacles in the path of technological progress in the contemporary industrial society.

II. *The American Patent System*

Originally established in an era of economic individualism, in which the operation of competitive forces was relatively free of interference, the American patent system fails to perform its function in an era characterized by economic concentration. The patent grant was designed originally "to promote the progress of science and the useful arts" by rewarding individuals for their discoveries. Throughout the years of its development, however, the patent system has evolved as a basis of monopoly power.

The basic source of difficulty in the American patent system is within the United States Patent Office. Faced with the impossible task of assigning to individuals the responsibility for an addition to the totality of human knowledge, the agency frequenely issues patents upon the basis of claims whose validity may be subject to serious question. Even an adequate staff of trained examiners would fail to enable the Patent Office to isolate the contribution of an individual to the public domain.

Possessing adequate financial reserves, corporate enterprises are able to prevent an individual patentee from exercising the rights bestowed upon him by the grant. By forcing the patentee into costly litigation, such corporate interests are enabled to gain control over a majority of the patents which threaten their economic positions. This result arises from the

fact that the courts have assigned to the patent grant all of the attributes of a property right, empowering the financially-strong corporation to force the individual inventor into the sale, lease, or assignment of his rights. The courts are frequently in no position to pass upon the technical validity of individual claims. Thus, the worthless grants, which should never have been issued by the Patent Office, continue to be validated by the courts.

The courts, almost consistently, have continued to validate such grants, regarding them as property and imposing limitations upon them only when they conflict with the antitrust laws. The result is that the corporate holders of patents are able to entrench further their positions of economic advantage and monopoly power. In private litigation, the interests of the public are no longer represented; worthless grants are validated and titles to segments of human knowledge are assigned to corporate enterprises for the promotion of their individual power. Patent abuses, arising from such monopoly power, exist in the forms of patent pooling and restrictions on prices, on production, or on the use of unpatented articles. Even when the courts find such practices to be violation of the public interest and the antitrust laws, they deny the Government its most essential power in this respect. The Government is able to force nothing more than a release of the patents themselves. The technical means and processes relating to the application of the grants remains within the control of the producers who have been found in restraint of trade.

III. *Investigations of Patent Abuses*

During the decade from 1935 to 1945, a number of agencies of the Federal Government conducted significant investigations of abuses of the patent right. The Federal Communications Commission, in its investigation of the telephone industry, discovered that the Bell Telephone System had used patents as a means of gaining virtually complete control of that industry. In addition, the Bell System conducted research in numerous allied fields with the intent of protecting its original invest-

ment in plant and equipment. Although such research enabled the Bell System to branch out into many fields, its cost was borne by subscribers to telephone service. In many instances, the fruits of such research were reflected in a further entrenchment of the economic position of the Bell System rather than in improved telephone service.

The Temporary National Economic Committee conducted four hearings on patents and discovered that, while patents were not of critical importance to the automobile industry, they permitted the Hartford-Empire Company and the Owens-Illinois Glass Company to dominate the glass industry and to suppress a number of potential competitors. In the beryllium industry, the T.N.E.C. uncovered evidence of the fact that foreign interests had been able to utilize the American patent system for the purpose of gaining control over the world market for that product. The testimony presented by the United States Department of Commerce in its proposals for changes in patent law and procedure is most significant. This evidence pointed to the fact that the American patent system is an obsolete institution. On the one hand, the fact that aggregates of capital can bring simultaneous suits for patent infringement in several judicial districts without regard for previous decisions permits the exertion of sufficient pressure to overcome the resistance of the defendant with small resources. On the other hand, the issuance procedure for patents provides sufficient opportunities for delay to permit the patent monopoly to be extended beyond the legally-contemplated seventeen years. Thus, it became evident that large corporations, through their increasing command over resources, had gained power in determining the direction of technical advances to a much larger extent than the entrepreneur of small means.

The investigations conducted by the Truman Committee and the Senate Patent Committee unearthed uses of patents by private interests to the detriment of the general welfare. The rubber industry arose as an example of this serious situation. In that industry, Standard Oil of New Jersey, through its

agreements with I. G. Farben, was found to have engaged in activities helpful to the Axis Nations and harmful to the United Nations during the Second World War. The source of difficulty was found to be the United States Patent System — under which both a foreign and a domestic producer were able to build a patent wall around themselves for the purpose of maintaining dominant economic positions. The investigations of the aluminum industry revealed that the Aluminum Company of America had been able to create a serious shortage of the light metal and, through its influence on Government agencies, had been able to assure itself of the greatest proportion of public funds spent for the wartime production of aluminum. The magesium investigation revealed a similar situation, showing that Basic Magnesium Incorporated had sought to impose exhorbitant royalties and fees upon the Government for the use of its facilities. In addition, I. G. Farben had been able to create a serious shortage of magnesium in this country through a prewar cartel agreement with Alcoa and the Dow Chemical Company.

IV. *Public Research Contracts*

Prior to the Second World War, industrial corporations dominated scientific research and development in the United States, the role of the Government in research being a minor one. Much of the prewar research financed with public funds was carried on in the field of agriculture. Little Federal aid was rendered to educational institutions — the centers of basic research — in other than agricultural fields. During the war emergency, the nation's science budget experienced a more than ten-fold increase, emphasis being placed upon technological developments rather than upon basic research, since the objectives were military in nature. Public funds, during the war, accounted for approximately three-fourths of total national research expenditures. Of the total Federal expenditures, approximately three-fourths was accounted for by the War and Navy Departments and the Office of Scientific Research and Development, which allocated the largest propor-

tion of their expenditures to industrial laboratories on a contract basis. In addition, the great bulk of such contracts was awarded to a small number of the corporations doing research for the Government during the war.

In the postwar period, the backlog of industrial projects brought forth private research expenditures far in excess of the decline in military expenditures, the emphasis being placed upon applied research designed to improve the economic position of the individual corporations. Federal expenditures continued at significantly high levels, were dominated by the War and Navy Departments, and were directed primarily toward applied research. The lack of support for basic science was comparable to that which existed in the prewar period.

One of the most significant problems arising out of wartime and postwar research programs was that of determining whether the Government or its research contractors should receive the patent rights to inventions resulting from federally-financed research. Almost without exception, the industrial laboratories under contract with the War or Navy Departments or the Office of Scientific Research and Development were granted such rights. In its investigation of Government patent practices and policies, the Department of Justice discovered that research contractors had been permitted to retain the patents to inventions in a majority of instances. The proposal of the Attorney General, that contracts require patents to inventions resulting from federally-financed research to be assigned to the Government, was opposed by the military agencies and spokesmen of industry.

Research contractors, who were able to retain commercial rights to inventions resulting from research financed with public funds, were placed in a privileged position. Provided with an advantage unavailable to his competitors, each selected contractor was enabled to suppress the use of the patents and to entrench further his economic position. The selection of a small number of corporations as research contractors resulted in a concentration of the ownership of such patents. Consti-

tuting a threat to the economic system, a policy which results in the promotion of the interests of a minority will operate to the detriment of the general welfare.

Inventions made under a Government contract have been financed through expenditures of public funds and are, consequently, a part of the public domain. The operation of the policy followed by the military services permits the establishment of private monopolies through the use of funds provided by the general public. By nature, such inventions are common property. It is only through the assignment to the Government of all inventions, resulting from governmentally-financed research contracts, that a free and equal availability of the inventions to both science and industry can be assured.

V. *National Science Policy*

Beginning in 1945, scientists, educators and Members of Congress engaged in an effort to establish a positive national science program. Four basic reasons were available to justify such efforts: (1) practically no basic research was carried on during the Second World War, since scientists were too busy developing practical applications of known principles; (2) European, rather than American, scientists had discovered a majority of the basic scientific principles upon which wartime developments were based; (3) there exists a serious deficit of trained American scientists as a result of the great wartime decline in doctoral degrees; and (4) private contributions to university research are on the decline at a time when fundamental scientific research is becoming increasingly costly.

Numerous bills proposing the establishment of a National Science Foundation were introduced in the Seventy-Ninth, Eightieth, and Eighty-First Congresses. Extensive Congressional hearings on science legislation brought forth hundreds of witnesses and produced thousands of pages of testimony. The witnesses can be classified into three general groups: (1) educators and scientists, supporting a majority of the bills introduced; (2) representatives of patent law and management

associations, supporting the proposed Foundation but opposing the patent provisions of a majority of the bills; and (3) representatives of industrial interests, opposing the Foundation in its entirety as constituting an unnecessary threat to private research activity. The extended campaign culminated in the passage of the National Science Foundation Act of 1950. With the approval by the President of this Act on May 10, 1950, the United States Government is prepared to engage in an exploitation of what appears to be the last frontier of the public domain. Private interests have jealously guarded scientific research throughout American industrial history, utilizing it in some instances to promote a more efficient utilization of resources, suppressing it in others to maintain their economic advantage in the market. With the passage of the National Science Foundation Act, the United States Government, for the first time in history, has initiated a positive national science policy.

Seeking to promote the progress of science and to advance the national health and welfare, this Act establishes the National Science Foundation as an independent agency of the Federal Government. Under the supervision of a twenty-four member, presidentially-appointed National Science Board, the Foundation consists of four divisions: (1) the Division of Medical Research, (2) the Division of Mathematical, Physical, and Engineering Sciences, (3) the Division of Biological Sciences, and (4) the Division of Scientific Personnel and Education. The Foundation is empowered to award scholarships and fellowships for scientific study in the various fields at educational institutions selected by the recipients of the aid. It is the objective of the Foundation to strengthen research in the basic sciences through this policy of increasing the supply of trained scientific personnel.

In addition, the Foundation is empowered to enter into research contracts with organizations, individuals, or Government agencies. It is authorized to disseminate scientific information, consistent with the national interest, through the publication or the sponsorship of the publication of such infor-

mation. The patent provisions of the Act assign to the Foundation the responsibility of protecting the public interest. There is, however, no provision for a free dedication to the public, or for an assignment to the Government, of patent rights to inventions resulting from federally-financed scientific research. The absence of provisions, permitting public owership of inventions and discoveries resulting from research financed with public funds, may be attributed, primarily, to the influence exerted upon Congress by representatives of industrial laboratories, the War Department, the Navy Department, and the Office of Scientific Research and Development. The patent provisions fail to correct a serious deficiency in our patent system. Although this Act was not intended to provide correctives for the inadequacies of the patent system, it seems to have provided an opportunity for the enhancement of the urgency of the patent problem. The influence of industrial interests and of the National Military Establishment is strongly evident, for the National Science Foundation Act of 1950 includes no restrictions upon the use of public funds for the promotion of private interests through public research contracts.

Appropriations for the Foundation were authorized to the extent of $500,000 for the fiscal year ending June 30, 1951 and a maximum of $15,000,000 for each subsequent fiscal year. This appropriation is meager, when it is noted that the annual cost of the Foundation had been estimated to be $40,000,000 in the first fiscal year and $122,500,000 in its fifth and subsequent years. The meager appropriation, in relation to the estimated cost of operation, will enable the Foundation to accomplish little more than the initial requisites of a national science program.

The dynamic nature of science, the fundamental element of technological progress, causes scientific research to be a national resource of greatest importance. Monopoly capitalism, in seeking a pecuniary gain, must control science — if it is to survive. Patent pooling and concentration have provided American industry with an effective tool for accomplishing

this end. The result is the creation of obstacles in the path of technological progress. So long as industry is able to maintain its control over science, a continuity of technological advances cannot be expected to occur. Democratic society, also, is dependent upon science and technology for its survival. Society must be able to benefit from new discoveries in the basic sciences, if it is to realize the fruits of technological progress. The general welfare can be promoted in this area, only if science is under popular, rather than under private, monopolistic, control — at least to an extent sufficient to absolve technology from the artificially-created obstacles in its path of progress. Antitrust actions, brought by the United States Department of Justice, have begun to serve that purpose.

However, the role which the United States Government must assume can no longer be a merely passive one. Additional public funds must be appropriated to insure society of epochal discoveries beyond the existing frontiers of science. New tools and techniques in the fundamental sciences must be made available to the entire society, in order that they may be utilized in the solution of practical problems in a continuous manner. The mere education of potential research workers in the basic sciences does not constitute an adequate solution. Basic research must be conducted in both public and private laboratories, through the use of public funds, wherever the flow of private funds proves to be inadequate.

Society must be assured of the availability of scientific knowledge for the promotion of the general welfare. Privately-controlled patents, where they are suppressed or used to the disadvantage of society as a whole, should be made available to any applicant who is willing to pay a reasonable royalty for the privilege. Patents on inventions resulting from publicly-financed research must be made available to society, either through being dedicated to the public and returned to the public domain or through assignment to the United States. Scientific information must be made available to all who desire to use it through publication and through a governmentally-

sponsored dissemination of scientific knowledge.

A free availability of new discoveries in the basic sciences will not only stimulate competition in production, but it will also promote continuous technological advances. Social and economic institutions must be sufficiently fluid to adjust readily to the advances that society demands. Although it may be expected that the utilization of the new tools and techniques will occur only slowly, the ultimate effects will be of great significance. Reduced capital requirements, constant improvement in production methods and in consumer products, and other economies will provide increased levels of production, lower consumer prices, and a more efficient allocation of resources for the economy as a whole. The formulation of a truly positive national science policy, toward the achievement of which the National Science Foundation Act of 1950 represents nothing more than a first endeavor, is essential to the complete realization of the benefits which technological progress can provide. In order for this to occur, social, economic, and legal institutions must be divorced from their rigidity to the greatest extent possible.

VITA

Erwin Eugene Liebhafsky was born at Shiner, Texas, on September 1, 1922. Following education in the Shiner Public Schools, he attended the Agricultural and Mechanical College of Texas and the University of Texas from 1939 until 1942.

He entered the United States Army in September, 1942, attended the University of Wyoming under the Army Specialized Training Program, served with a Civil Affairs Detachment in France and Belgium and with a Military Government Detachment in Germany.

Upon his discharge from the Army in January, 1946, he re-entered Texas A. and M. College and was graduated as a distinguished student with a Bachelor of Science Degree in Business in 1947. He earned the Master of Science Degree in Economics from Texas A. and M. in 1948 and entered the Graduate College of the University of Illinois in that year.

He held a graduate assistantship in economics at Texas A. and M. from 1947 to 1948 and a graduate assistantship in economics at the University of Illinois from 1948 to 1950. His teaching experience includes courses in principles of economics, labor economics, and money and banking. He has been appointed to an Instructorship in Economics at Cleveland College, Western Reserve University, Cleveland, Ohio, for the 1950-1951 academic year.

He is a member of Artus, of the American Association of University Professors, and of the American Economic Association.